

## **REMARKS**

This Preliminary Amendment cancels, without prejudice, claims 1 to 15 in the underlying PCT Application No. PCT/EP2004/011241 and adds new claims 16 to 29. The new claims, inter alia, conform the claims to United States Patent and Trademark Office rules and does not add any new matter to the application.

In accordance with 37 C.F.R. § 1.125(b), the Substitute Specification (including the Abstract) contains no new matter. The amendments reflected in the Substitute Specification (including Abstract) are to conform the Specification and Abstract to United States Patent and Trademark Office rules or to correct informalities. As required by 37 C.F.R. §§ 1.121(b)(3)(ii) and 1.125(c), a Marked-Up Version of the Substitute Specification comparing the Specification of record and the Substitute Specification also accompanies this Preliminary Amendment. Approval and entry of the Substitute Specification (including Abstract) are respectfully requested.

The underlying PCT Application No. PCT/EP2004/011241 includes an International Search Report, dated January 27, 2005, a copy of which is included. The Search Report includes a list of documents that were considered by the Examiner in the underlying PCT application.

The underlying PCT Application No. PCT/EP2004/011241 also includes an International Preliminary Examination Report, dated November 29, 2005. An English translation of the International Preliminary Examination Report and annex thereto are included herewith.

It is respectfully submitted that the subject matter of the present application is new, non-obvious and useful. Prompt consideration and allowance of the application are respectfully requested.

Respectfully submitted,

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## POWER-ASSISTED STEERING SYSTEM OR POWER STEERING SYSTEM

**FIELD OF THE INVENTION**

The present invention relates to a power-assisted steering system or power steering system ~~according to the species defined in Claim 1.~~

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**BACKGROUND INFORMATION**

In power-assisted steering systems or power steering systems having an electric motor, which drives a worm gear mechanism that includes a composite gear wheel preferably, e.g., having  
10 a plastic ring gear, the composite gear wheel ~~ensures~~ may ensure a high degree of running smoothness with high economic efficiency, when the worm gear mechanism has large dimensions and is paired with metallic wheels having a high degree of edge smoothness. Composite gear wheels are ~~well-known~~  
15 conventional.

**PCT International Published Patent Application No. WO 01/44694**

[[Al]] describes a composite gear wheel, which is suitable for a worm gear mechanism of a power-assisted steering system or  
20 power steering system, having a two-piece ring gear that is screwed onto a hub. The hub has an annular flange on one axial end. The ring gear is form-locked to the hub by a disk, which is positioned in the axial direction of the composite gear wheel, on the opposite side of the annular flange. Both  
25 the disk and the annular flange of the hub have an annular projection, which, in each instance, engages with an annular groove on the side faces of the ring gear in the axial direction of the composite gear wheel and secures the ring gear in the radial direction.

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To transmit the torque from the ring gear to the hub or vice versa, threaded bolts are guided through the disk, the ring

gear, and the annular flange of the hub. The individual component parts and, in particular, the threaded bolts are not self-centering, which is why the power transmission in the composite gear wheel and the assembly sequence of the composite gear wheel are not optimized.

#### SUMMARY

~~The object~~ Example embodiments of the present invention ~~is to improve~~ may provide a composite gear wheel for power-assisted steering systems or power steering systems having an electric motor that drives a worm gear mechanism, so that the assembly of the gear wheel ~~[[is]]~~ may be simplified and the power transmission in the composite gear wheel ~~[[is]]~~ may be uniform.

~~In the case of~~ power-assisted steering systems or power steering systems having an electric motor that drives a worm gear mechanism, ~~the object is achieved by~~ a composite gear wheel may be provided having the features of ~~Claim 1~~ described herein.

Since the annular, axial projection of the disk has a depression in the axial direction and a keyed connection in the tangential direction is rendered possible at an axial side face of the ring gear by a projection and by a depression, a centering aid which ~~allows~~ may allow simple, rapid assembly of the composite gear wheel ~~[[is]]~~ may be provided in the tangential direction between the disk and the ring gear. ~~In particular~~ For example, when a plurality of depressions are provided, it ~~[[is]]~~ may be possible to achieve uniform torque transmission between the hub, disk, and ring gear, distributed over the circumference of the disk.

~~Advantageous embodiments are derived from the dependent claims.~~

The keyed connection between the disk and the ring gear ~~is accomplished~~ may be provided by projections and depressions on the disk, and by complementary projections and depressions in the side face of the ring gear in, in each instance, the axial direction of the composite gear wheel. The depressions and projections form a drive-type toothed section in the tangential direction. It ~~is useful for~~ may be provided that the projections and depressions ~~to be~~ are block-shaped and ~~to be~~ are positioned about the circumference of the disks and the ring gear, in that the depressions rectangularly pass through the originally annular, axial projection on the circumference of the disk in a radial direction. The depressions may also pass through the annular, axial projection, having curved edges. The disk may be formed in one piece with the hub or suitably fastened to the hub in a form-locked or force-locked manner. The ring gear ~~is preferably~~ may be axially fixed between two disks and fastened to the hub by them in a rotatably fixed manner. The shape, cross-sectional shape, and the inner and outer diameters of the second disk ~~are preferably~~ may be similar to or the same as those of the first disk. The second disk ~~likewise~~ has an annular, axial projection, which is interrupted by one or more depressions and is directed ~~towards~~ toward an axial side face of the ring gear.

The shape and the number of depressions and projections on the second disk and the side face of the ring gear ~~are preferably~~ may be the same as on the first disk and on its complementary side face of the ring gear. They ~~are preferably~~ may be conically interlocking.

The second disk ~~[[is]]~~ may be connected to the ring gear and/or to the first disk fastened to the hub, using rivets or threaded bolts or friction welding.

The design arrangement of the composite gear wheel according to the present invention is may be suitable for making the ring gear out of a thermoplastic or duroplastic synthetic material. The composite gear wheel is preferably may be capable of producing a low-noise gear unit of a power-steering system or power-assisted steering system of a vehicle, and in particular, e.g., as a worm wheel of a steer-by-wire system.

10 The Example embodiments of present invention is now are described in more detail on the basis of an exemplary embodiment and is represented by the enclosed drawing. The figures show: below with reference to the appended Figures.

15 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a longitudinal ~~cross-section~~ cross-sectional view of a composite gear wheel take along line II-II illustrated in Fig. 2[[]].

20 Fig. 2 a view of the illustrates a composite gear wheel in arrow direction I illustrated in Fig. 1, and.

Fig. 3 is an exploded view of a further composite gear wheel.

25 DETAILED DESCRIPTION

~~Shown~~ Illustrated in the drawing Figures is a composite gear wheel, as is used in a worm gear mechanism for power-assisted steering systems or power-steering systems, where the gear wheel is used as a worm wheel that engages with a worm or worm gear, in order to provide steering assistance or to produce the entire required steering force.

~~Shown in~~ Figure 1 is a longitudinal ~~cross-section~~ cross-sectional view of a composite gear wheel 1 taken along line II-II illustrated in Fig. 2. Composite gear wheel 1 is made

~~up of~~ includes: a cylindrical hub 3, on whose one axial end 14 a first disk 2 having a crimped cross-section is formed in one piece; of an annular ring gear 4; and ~~[[of]]~~ a second disk 12. Ring gear 4 is made of a thermoplastic synthetic material.

5 First and second disks 2, 12 terminate ring gear 4 in the axial direction and are pressed against it with the aid of six rivets 15, which pass through disks 2, 12 and ring gear 4. Hub 3 and first and second disks 2, 12 are made of metal.

10 On their outer circumferential edges, the two disks 2, 12 have an annular projection 5, 5' facing ring gear 4 in the axial direction. Annular projections 5, 5' are interrupted by depressions 6, 6', which have a rectangular cross-section when viewed in the radial direction of disks 2, 12 (cf. Fig. 3).

15 In the composite state of composite gear wheel 1, tooth-like projections 5, 5' formed in this manner extend into depressions 7, 7' on axial side faces 8, 8' of ring gear 4. In this manner, a keyed connection with ring gear 4 is produced in the radial and tangential directions of disks 2,

20 12. Depressions 7, 7' and projections 5, 5' ~~are preferably~~ may be formed comically with respect to each other, which ~~simplifies~~ may simplify the assembly of composite gear wheel 1. Depressions 6, 6' on disks 2, 12 are positioned at the same tangential distance 9 from each other and form a drive-type toothed section 10, which points in the axial direction ~~towards~~ toward ring gear 4, at the outer circumferential edge of disks 2, 12. Instead of in a conically even manner, edges 11 of projections 5, 5' may also ~~run towards~~ extend toward depressions 7, 7' in a conically curved manner.

30 As ~~shown~~ illustrated by Fig. 2 in a plan view of assembled gear wheel 1 in arrow direction I illustrated in Fig. 1, and as ~~shown~~ illustrated by Fig. 3 in an exploded view of a further assembled gear wheel 1, rivets 15 are positioned  
35 axially symmetrically with respect to each other in the radial

direction in the vicinity of the hub and are mounted flush with the outer contour of disks 2, 12. Ring gear 4 has straight-cut teeth. Inner diameter 16 of ring gear 4 extends into the disk support, which means that elastic, radial and axial expansion of plastic ring gear 4 caused by, for instance example, water absorption or the effect of temperature may occur without acting on the connecting points of rivets 15.

In contrast to gear wheel 1 ~~shown~~ illustrated in Figures 1 and 2, gear wheel 1 illustrated in Figure 3 ~~is made up of~~ includes a hub 3, two disks 2, 12, and a ring gear 4, which means that hub 3 and disks 2, 12 represented separate component parts to be connected in a form-locked manner.

Abstract.

**ABSTRACT**

~~The invention relates to~~ **In** a power-assisted steering system or power steering system having an electric motor, which  
5 drives a worm gear mechanism that has a composite gear wheel in the form of a worm wheel, the worm wheel ~~having~~ **includes** a ring gear ~~(4)~~ connectible to a hub ~~(3)~~ via a first disk ~~(2)~~, and an annular projection ~~(5)~~ of the first disk ~~(2)~~ axially engaging **engages** with the ring gear ~~(4)~~.

10 In order to improve the centering of the component parts of the composite gear wheel ~~(1)~~ in the tangential direction, and in order to render the power transmission in the gear wheel ~~(1)~~ uniform, the annular projection ~~(5)~~ on the first disk ~~(2)~~  
15 is provided with one or more depressions ~~(6)~~ in the axial direction to form tooth-like projections ~~(5)~~, which form a drive-type toothed section ~~(10)~~ and engage with depressions ~~(7)~~ on an axial side face ~~(8)~~ of the ring gear ~~(4)~~.

20 ~~(Fig. 3)~~